

## The Discovery of Clinical Anatomy of Frontal Lobe: Evolution of Observational and Experimental Human Studies

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The earliest records of human brain and its motor function date to early 3000 BC. According to the Edwin Smith Papyrus, the surgeons in ancient Egypt made the first observations of loss of motor functions in soldiers who returned with head injuries from the battlefield. In the Greek era, Hippocrates predicted that brain controlled the movements of the body. Thomas Willis, an English physician set out the earliest experiments on brain, thus was named "father of experimental brain physiology". However, his experimental studies were limited to animals.

In 1760s, Morgagni identified that speech was affected by the lesions of the brain, particularly those involving the anterior part. With the famous case of American labourer Phineas Gage, who survived an accidental impalement of a rod through his brain in 1840s, higher functions of frontal lobe could be predicted by the clinicians. In 19<sup>th</sup> century, a famous French surgeon named Broca accurately linked the function of the inferior frontal gyrus with motor aphasia by observing a series of patients and conducting post mortem studies on them.

Earliest experimental neuroanatomical and neurophysiological studies were conducted in 18<sup>th</sup> century. Rolando, Flourens and Fritsch were among those who pioneered neurophysiological studies on animal brains using electric stimulation techniques. However, human studies were initiated only in the last decade of 19<sup>th</sup> century where Horsley, a neurosurgeon, discovered that stimulation of the human brain substance in front of the central cerebral sulcus could give rise to motor functions. Subsequently, Bartholow applied electrodes on the motor cortex of his sister after piercing dura mater and observed muscle contractions of the opposite side following applying an electric potential. Inspired by these experiments, Krause conducted hundreds of human brain stimulation trials in 20<sup>th</sup> century. Afterwards, Wilder Penfield, a Canadian-American neurosurgeon described Montreal procedure, where he stimulated certain parts of the brain to identify the region which was responsible for the origin of seizures in patients with refractory epilepsy before surgically excising the said region. With his experiments, he was able to define the motor homunculus of the brain.

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